FINAL REPORT
June 2008
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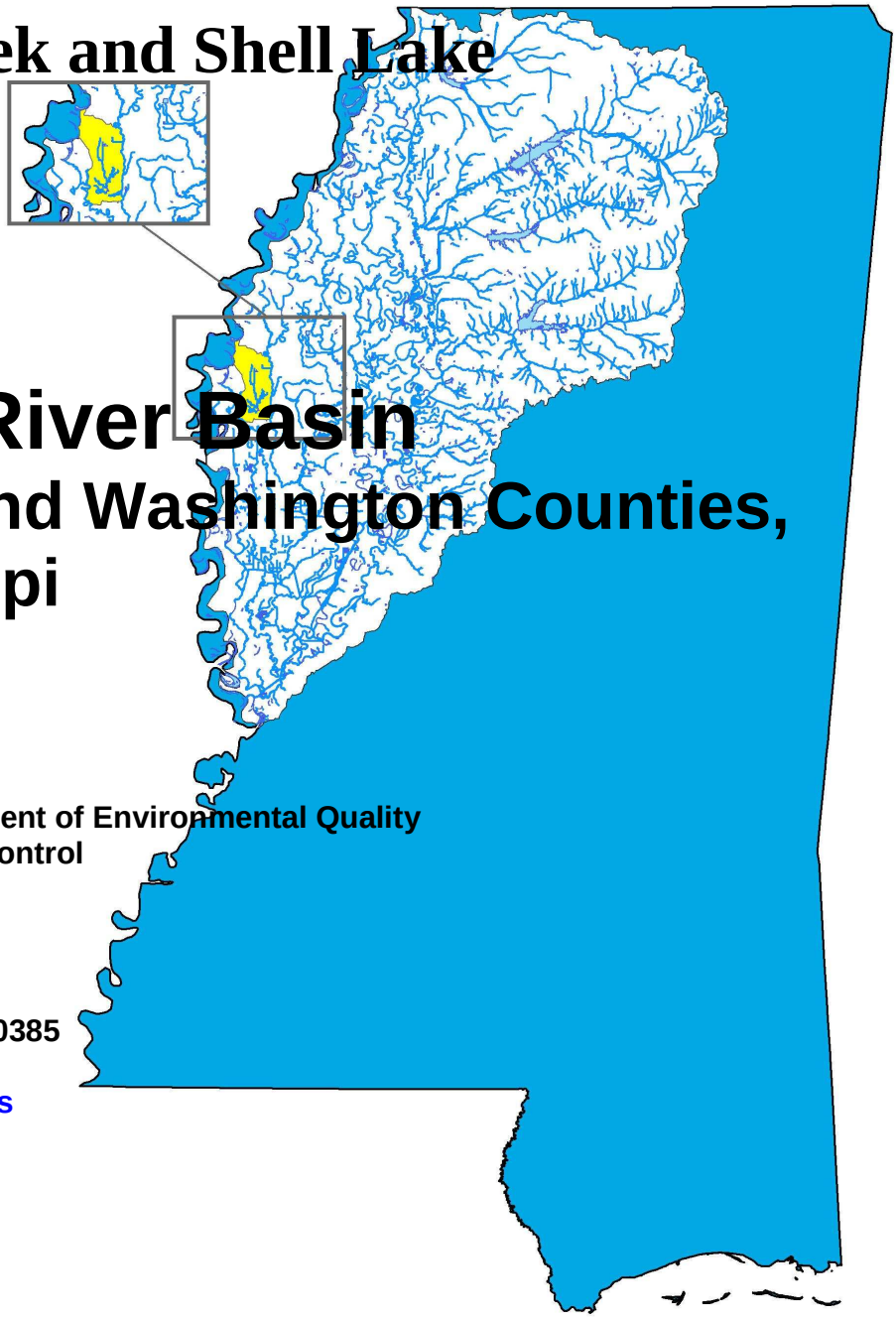
Total Maximum Daily Load

Nutrients and Organic Enrichment / Low DO For

Clear Creek and Shell Lake



Yazoo River Basin

Bolivar and Washington Counties, Mississippi

Prepared By

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FOREWORD

This report has been prepared in accordance with the schedule contained within the federal consent decree dated December 22, 1998. The report contains one or more Total Maximum Daily Loads (TMDLs) for water body segments found on Mississippi's 1996 Section 303(d) List of Impaired Water bodies. Because of the accelerated schedule required by the consent decree, many of these TMDLs have been prepared out of sequence with the State's rotating basin approach. The implementation of the TMDLs contained herein will be prioritized within Mississippi's rotating basin approach.

The amount and quality of the data on which this report is based are limited. As additional information becomes available, the TMDLs may be updated. Such additional information may include water quality and quantity data, changes in pollutant loadings, or changes in landuse within the watershed. In some cases, additional water quality data may indicate that no impairment exists.

Conversion Factors

To convert from	To	Multiply by	To convert from	To	Multiply by
$mile^2$	acre	640	acre	ft^2	43560
km^2	acre	247.1	days	seconds	86400
m^3	ft^3	35.3	meters	feet	3.28
ft^3	gallons	7.48	ft^3	gallons	7.48
ft^3	liters	28.3	hectares	acres	2.47
cfs	gal/min	448.8	miles	meters	1609.3
cfs	MGD	0.646	tonnes	tons	1.1
m^3	gallons	264.2	µg/l * cfs	gm/day	2.45
m^3	liters	1000	µg/l * MGD	gm/day	3.79

Fraction	Prefix	Symbol	Multiple	Prefix	Symbol
10^{-1}	deci	d	10	deka	da
10^{-2}	centi	c	10^2	hecto	h
10^{-3}	milli	m	10^3	kilo	k
10^{-6}	micro	µ	10^6	mega	M
10^{-9}	nano	n	10^9	giga	G
10^{-12}	pico	p	10^{12}	tera	T
10^{-15}	femto	f	10^{15}	peta	P
10^{-18}	atto	a	10^{18}	exa	E

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TMDL INFORMATION PAGE

Table 1. Listing Information

Name	ID	County	HUC	Evaluated Cause
Clear Creek	MS389E	Bolivar	08030207	Nutrients and Organic Enrichment / Low DO
Near Lees Flat from headwaters excluding Shell Lake to the confluence with Bogue Phalia				
Shell Lake	MS390SL	Washington	08030207	Cause Unknown
Near Elizabeth Oxbow Lake from Clear Creek to the confluence with Bogue Phalia				

Table 2. Water Quality Standards

Parameter	Beneficial use	Water Quality Criteria
Nutrients	Aquatic Life Support	Waters shall be free from materials attributable to municipal, industrial, agricultural, or other dischargers producing color, odor, taste, total suspended solids, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated uses.
Dissolved Oxygen	Aquatic Life Support	DO concentrations shall be maintained at a daily average of not less than 5.0 mg/l with an instantaneous minimum of not less than 4.0 mg/l

Table 3. Total Maximum Daily Load for Clear Creek and Shell Lake

	WLA lbs/day	LA lbs/day	MOS	TMDL lbs/day
TBODu	**56.24**	**2228.05***	Implicit	**2284.59**
Total Nitrogen	**8.45**	**1170.58**	Implicit	**1179.03**
Total Phosphorous	**3.82**	**175.84**	Implicit	**179.66**

*Based on a background concentration of 2 mg/l at the annual average flow, loads will be lower for flows less than the annual average

Table 4. Point Source Loads for Clear Creek and Shell Lake

Permit	Facility	Flow MGD	TN Load lbs/day	TP Load lbs/day	TBODu lbs/day
MS0020672	**Benoit POTW**	**0.088**	**8.45**	**3.82**	**56.24**

EXECUTIVE SUMMARY

This TMDL has been developed for Clear Creek and Shell Lake which were placed on the Mississippi 2006 Section 303(d) List of Impaired Water Bodies. Clear Creek was listed due to evaluated causes of sediment, organic enrichment / low dissolved oxygen, and nutrients. Sediment will be addressed in a separate TMDL report. Shell Lake was listed due to an unknown evaluated cause. This TMDL will provide an estimate of the total biochemical oxygen demand (TBODu), total nitrogen (TN) and total phosphorus (TP) allowable in these water bodies.

Mississippi does not have water quality standards for allowable nutrient concentrations. MDEQ currently has a Nutrient Task Force (NTF) working on the development of criteria for nutrients. An annual concentration of 1.05 mg/l is an applicable target for TN and 0.16 mg/l for TP for water bodies located in the western side of the Delta. MDEQ is presenting these preliminary target values for TMDL development which are subject to revision after the development of numeric nutrient criteria.

The Clear Creek and Shell Lake Watershed is located in HUC 08030207. The listed portion of Clear Creek is near Lees Flat from the headwaters excluding Shell Lake to the confluence with Bogue Phalia. The listed portion of Shell Lake is near Elizabeth Oxbow Lake from Clear Creek to the confluence with Bogue Phalia. The location of the watershed for the listed segments is shown in Figure 1.

The limited nutrient data and estimated existing ecoregion concentrations indicate reductions of nutrients can be accomplished with installation of best management practices.

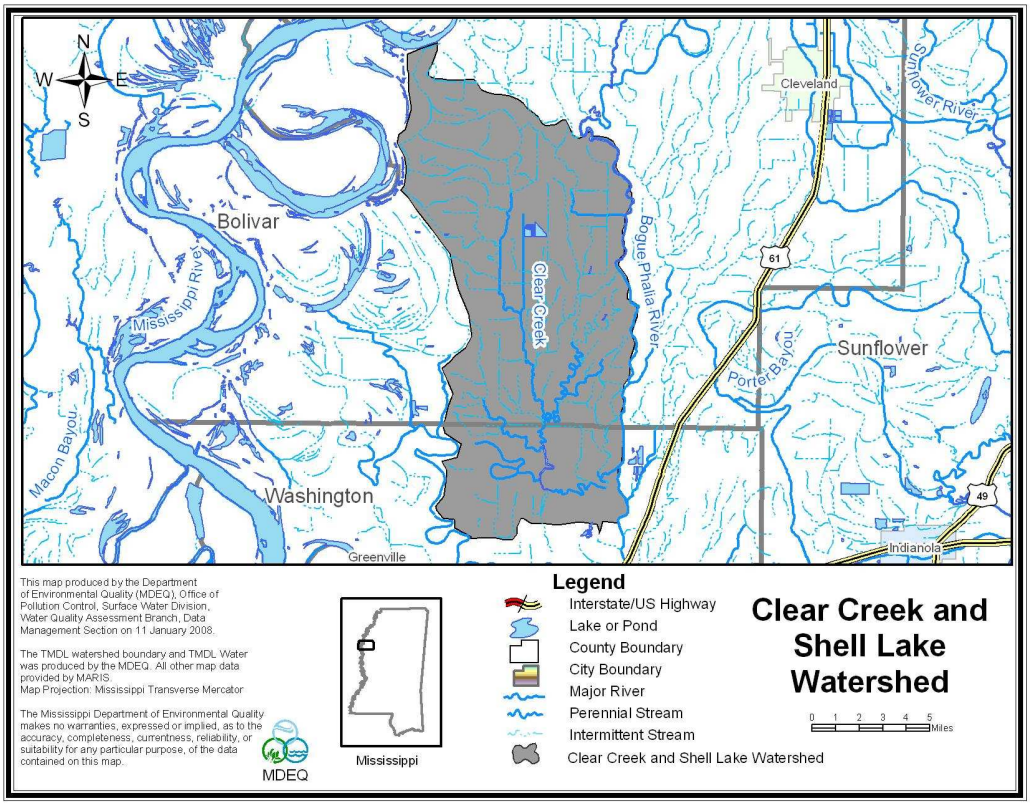


Figure 1. Clear Creek and Shell Lake

INTRODUCTION

1.1 Background

The identification of water bodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those water bodies are required by Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR part 130). The TMDL process is designed to restore and maintain the quality of those impaired water bodies through the establishment of pollutant specific allowable loads. This TMDL has been developed for the 2006 §303(d) listed segments shown in Figure 2.

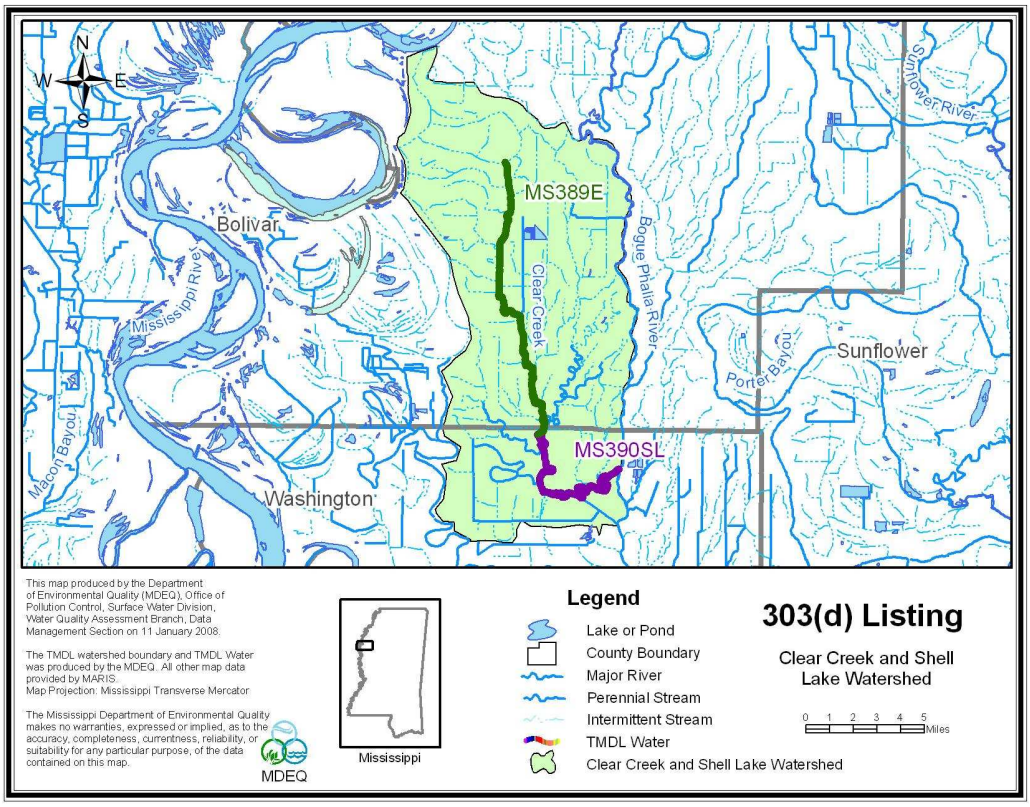


Figure 2. Clear Creek and Shell Lake §303(d) Listed Segments

1.2 Listing History

The impaired segments were listed due to evaluating the watershed for potential impairment. There is limited data available in the watershed.

There are no state criteria in Mississippi for nutrients. These criteria are currently being developed by the Mississippi Nutrient Task Force in coordination with EPA Region 4. MDEQ proposed a work plan for nutrient criteria development that has been mutually agreed upon with EPA Region 4 and is on schedule according to the approved timeline for development of nutrient criteria (MDEQ, 2007).

1.3 Applicable Water Body Segment Use

The water use classifications are established by the State of Mississippi in the document *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2007). The designated beneficial use for the listed segments is Fish and Wildlife.

1.4 Applicable Water Body Segment Standard

The water quality standard applicable to the use of the water body and the pollutant of concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2007). Mississippi's current standards contain a narrative criteria that can be applied to nutrients which states "*Waters shall be free from materials attributable to municipal, industrial, agricultural, or other discharges producing color, odor, taste, total suspended or dissolved solids, sediment, turbidity, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated use* (MDEQ, 2007)."

In the 1999 Protocol for Developing Nutrient TMDLs, EPA suggests several methods for the development of numeric criteria for nutrients (USEPA, 1999). In accordance with the 1999 Protocol, "*The target value for the chosen indicator can be based on: comparison to similar but unimpaired waters; user surveys; empirical data summarized in classification systems; literature values; or professional judgment*."

1.5 Nutrient Target Development

Numeric nutrient criteria are not currently available for Delta streams. Biotic indices such as the MBISQ index used to assess attainment of aquatic life use in streams in other parts of Mississippi are also not available for the Delta. Therefore, a percentile approach has been used to suggest nutrient targets applicable for Delta streams, following the approach suggested by EPA (EPA, 2000).

USGS data were partitioned into eastern and western nutrient distributions. USGS nutrient data for the western portion of the Delta were combined with MDEQ's WADES nutrient data. These two data distributions were used to derive the nutrient concentration associated with the lower quartile following procedures similar to those used by EPA (2000) in developing nutrient criteria recommendations for rivers and streams. The lower quartile nutrient concentrations associated with these data sets are shown in the Table 5 below.

For this TMDL, MDEQ is presenting preliminary targets for TN and TP. An annual concentration 1.05 mg/l is an applicable target for TN and 0.16 mg/l for TP for water bodies located in the western portion of the Delta. However, MDEQ is presenting these preliminary target values for TMDL development which are subject to revision after the development of nutrient criteria, when the work of the NTF is complete.

Table 5. Nutrient Targets for the Delta Wadeable Streams

Lower Quartile Values		
Nutrient Conc. (mg/l)	East (USGS)	West (WADES/USGS)
TP	0.09	0.16
TN	0.58	1.05

WATER BODY ASSESSMENT

2.1 Water Quality Data

There are limited data available for Clear Creek and there are no data available for Shell Lake. The water quality data for Clear Creek is given in Table 6.

Table 6. Water Quality Data for Clear Creek

Station	Data Source	Date	DO avg (mg/l)	DO max (mg/l)	DO min (mg/l)	DO inst (mg/l)	TN	TP
E031	ERDC	5/23/06				6.61	6.09	0.18
E031	ERDC	5/23/06				6.61	6.07	0.16
E031	USGS	6/7/06				7.3		
E031	USGS	6/7/06				7.41		
D029	USGS	9/10/07				14.69	1.61	0.33
D029	USGS	9/10/07 17:00 – 9/13/07 11:00	7.19	15.78	1.22			

2.2 Assessment of Point Sources

There is one NPDES point source in the watershed.

Benoit POTW
NPDES No. MS0020672
Bolivar County
Benoit, Mississippi

This water permit is a minor facility and discharges 0.088 MGD to Burrows Bayou. The current NPDES permit for the Benoit POTW, issued October 30, 2007, calls for phased BOD5 limits. The current or phase I limit is 45 mg/L BOD5 with a phase II limit of 10 mg/L BOD5. The Benoit POTW must comply with the phase II limits within three years of the permit issuance. The estimated nutrient concentration from the effluent is 11.5 mg/l TN and 5.2 mg/l TP. These nutrient concentrations result in loads of 8.45 lbs/day TN and 3.82 lbs/day TP or 0.7% and 2.1% respectively of the allowable nutrient load in the watershed. Thus, the Benoit POTW is not considered to be a significant source of pollutants in this watershed. The determination of the WLA is shown in Table 8 and Table 9.

2.3 Assessment of Non-Point Sources

Non-point loading of nutrients and organic material in a water body results from the transport of the pollutants into receiving waters by overland surface runoff, groundwater infiltration, and atmospheric deposition. The two primary nutrients of concern are nitrogen and phosphorus. Total nitrogen is a combination of many forms of nitrogen found in the environment. Inorganic nitrogen can be transported in particulate and dissolved phases in surface runoff. Dissolved inorganic nitrogen can be transported in groundwater and may enter a water body from groundwater infiltration. Finally, atmospheric gaseous nitrogen may enter a water body from atmospheric deposition.

Unlike nitrogen, phosphorus is primarily transported in surface runoff when it has been sorbed by eroding sediment. Phosphorus may also be associated with fine-grained particulate matter in the atmosphere and can enter streams as a result of dry fallout and rainfall (USEPA, 1999). However, phosphorus is typically not readily available from the atmosphere or the natural water supply (Davis and Cornwell, 1988). As a result, phosphorus is typically the limiting nutrient in most non-point source dominated rivers and streams, with the exception of watersheds which are dominated by agriculture and have high concentrations of phosphorus contained in the surface runoff due to fertilizers and animal excrement or watersheds with naturally occurring soils which are rich in phosphorus (Thomann and Mueller, 1987).

Watersheds with a large number of failing septic tanks may also deliver significant loadings of phosphorus to a water body. All domestic wastewater contains phosphorus which comes from humans and the use of phosphate containing detergents. Table 7 presents the estimated loads from various land use types in the Delta based on information from USDA ARS Sedimentation Laboratory. (Shields, et. al., 2008)

The watershed contains mainly cropland but also has different landuse types, including urban, water, and wetlands. The land use information for the watershed is based on the National Land Cover Database (NLCD). Cropland is the dominant landuse within this watershed. The landuse distribution for the Clear Creek and Shell Lake Watershed is shown in Table 5 and Figure 3. By multiplying the landuse category size by the estimated nutrient load, the watershed specific estimate can be calculated. Table 5 presents the estimated loads, the target loads, and the reductions needed to meet the TMDLs.

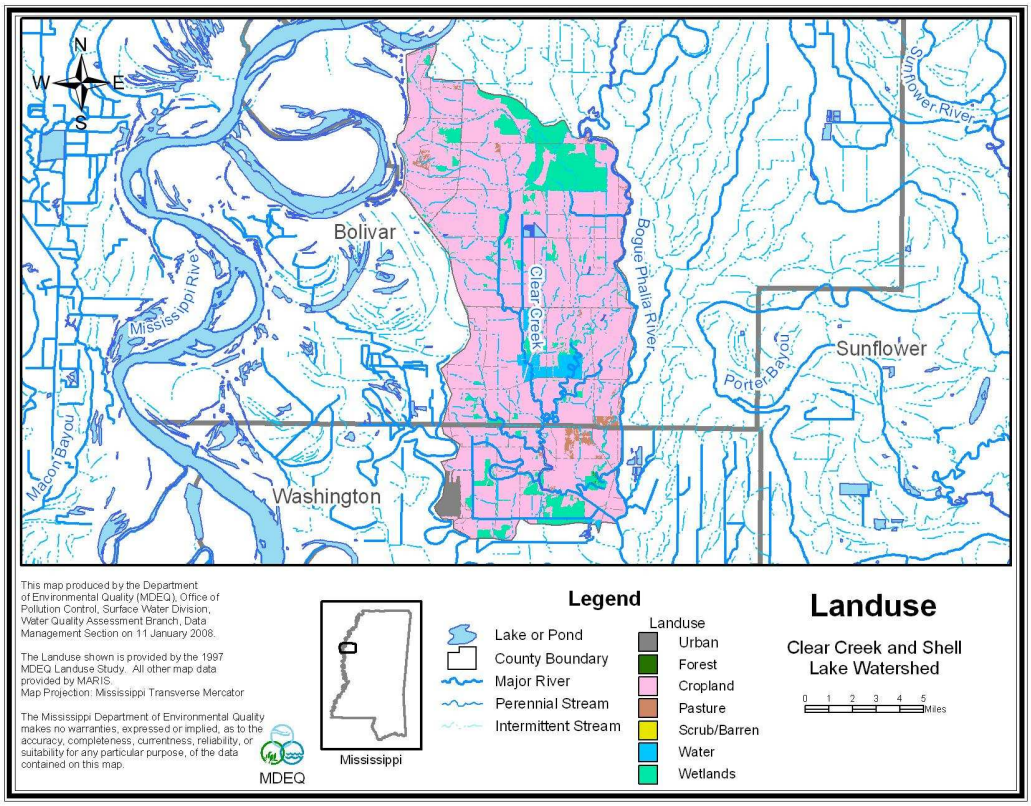
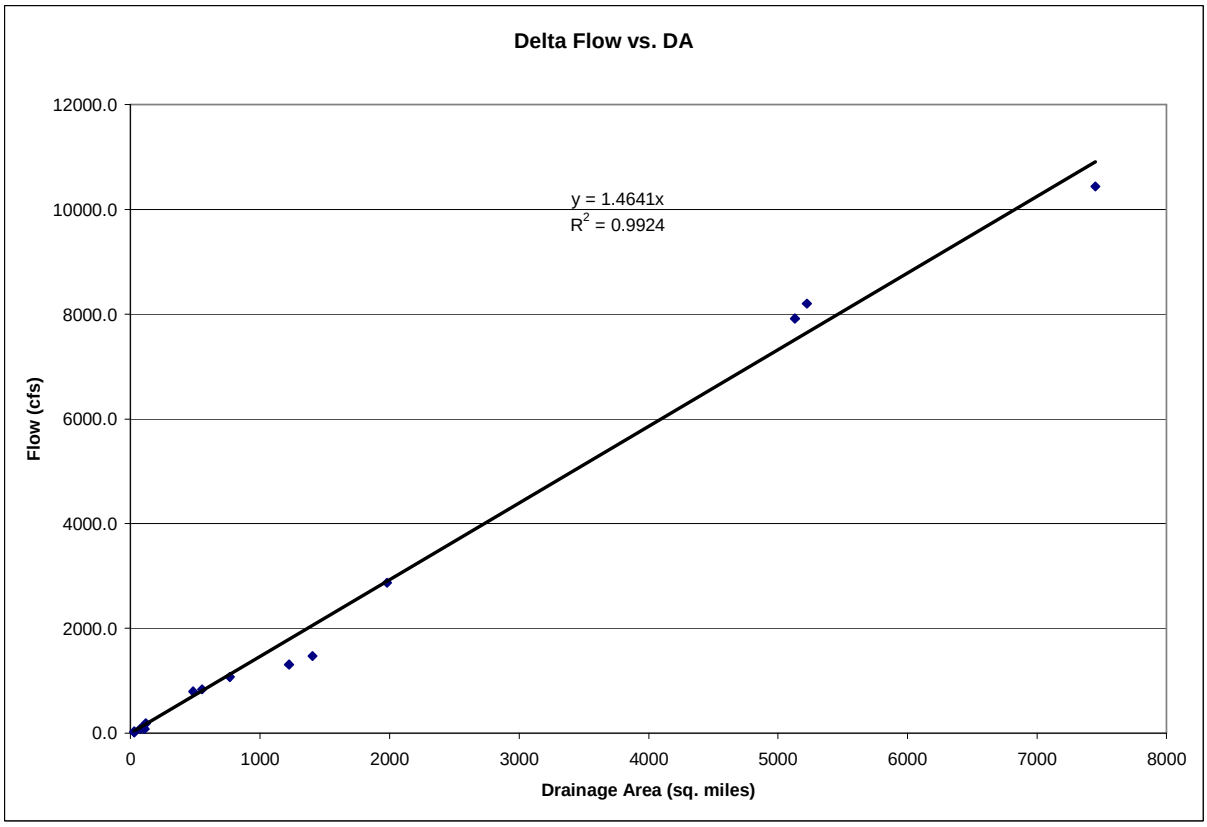


Figure 3. Clear Creek and Shell Lake Watershed Landuse

2.4 Estimated Existing Load for Total Nitrogen and Total Phosphorus

The average annual flow in the watershed was calculated by utilizing the flow vs. watershed area graph shown in figure 4 below. All available gages were compared to the watershed size. A very strong correlation between flow and watershed size was developed for the Delta. The equation for the line that best fits the data was then used to estimate the annual average flow for the Clear Creek watershed. The TMDL target TN and TP loads were then calculated, using Equation 1 and the results are shown in Table 7.

Figure 4. Delta Drainage Area to Flow Comparison



Nutrient Load (lb/day) = Flow (cfs) * 5.394 (conversion factor)* Nutrient Concentration (mg/L) (Equation 1)

Table 7. TMDL Calculations and Watershed Sizes

Water body	**Clear Creek and Shell Lake**		**Water**	**Urban**	**Scrub / Barren**	**Forest**	**Pasture / Grass**	**Cropland**	**Wetland**	**Total**	
		Acres	2186.36	3150.45	2.67	30.91	966.97	73372.28	11288.54	90,998.2	
Land Use	**TN kg/mile^2**	Percent	2.40%	3.46%	0.00%	0.03%	1.06%	80.63%	12.41%	100.00%	
Forest	111.3	Miles^2 in watershed	3.4	4.9	0.0	0.0	1.5	114.6	17.6	142.2	
Pasture	777.0	Flow in cfs based on area	208.2	cfs							
Cropland	10956.2										
Urban	287.8	TN Load kg/mi^2 annual avg	259.0	287.8	111.3	111.3	777.0	10956.2	259.0		
Water	259.0	TP Load kg/mi^2 annual avg	259.0	4.3	61.3	61.3	1295.0	5490.9	259.0		
Wetland	259.0										
aquaculture	2590.0	TN Load kg/day	2.4	3.9	0.0	0.0	3.2	3441.3	12.5	3463.3	kg/day
		TP Load kg/day	2.4	0.1	0.0	0.0	5.4	1724.7	12.5	1745.0	kg/day
Land Use	**TP kg/mile^2**										
Forest	61.3	TN target concentration	1.05	mg/l							
Pasture	1295.0	TP target concentration	0.16	mg/l							
Cropland	5490.9										
Urban	4.3	TN estimated concentration	6.80	mg/l							
Water	259.0	TP estimated concentration	3.43	mg/l							
Wetland	259.0										
aquaculture	2590.0	TN target load	1179.03	lbs/day							
		TP target load	179.66	lbs/day							
		TBODu target load	2245.77	lbs/day							
		TN estimated load per day	7635.32	lbs/day							
		TP estimated load per day	3847.13	lbs/day							
		TN reduction needed	84.56%								
		TP reduction needed	95.33%								

The land use calculations are based on 2004 data. The nutrient estimates are based on USDA ARS. The TMDL targets are based on EPA guidance for calculation of targets when considering all available data.

ALLOCATION

3.1 Wasteload Allocation

There is one point source in the impaired segments, the Benoit POTW, NPDES #MS0020672. The current NPDES permit for the Benoit POTW, issued October 30, 2007, calls for phased BOD5 limits. The current or phase I limit is 45 lbs/day BOD5 with a phase II limit of 10 lbs/day BOD5. The Benoit POTW must comply with the phase II limits within three years of the permit issuance. The TBODu wasteload allocation is set to the phase I limits and is given in Table 8. The estimated nutrient concentration from the effluent is 11.5 mg/l TN and 5.2 mg/l TP and the resulting loads are given in Table 9. Given the relative size of the WLA in comparison to the TMDL and the LA, the Benoit POTW is not considered to be a significant source of pollutants in this watershed and no reductions to the WLA are needed. Future permits will be considered in accordance with Mississippi's *Wastewater Regulations for National Pollutant Discharge Elimination System (NPDES) Permits, Underground Injection Control (UIC) Permits, State Permits, Water Quality Based Effluent Limitations and Water Quality Certification*(1994).

Table 8. TBODu Wasteload Allocation

Facility Name	CBODu (lbs/day)	NBODu (lbs/day)	TBODu (lbs/day)	Percent Reduction
Benoit POTW	49.54	6.71	56.24	0%

Table 9. Nutrient Wasteload Allocation

Facility Name	Existing Estimated TN Point Source Load (lbs/day)	Allocated Average TN Point Source Load (lbs/day)	Existing Estimated TP Point Source Load (lbs/day)	Allocated Average TP Point Source Load (lbs/day)
Benoit POTW	8.45	8.45	3.82	3.82

3.2 Load Allocation

Best management practices (BMPs) should be encouraged in the watersheds to reduce potential TBODu, TN, and TP loads from non-point sources. The LA for TBODu, TN, and TP was calculated by subtracting the WLA from the TMDL. For land disturbing activities related to silvaculture, construction, and agriculture, it is recommended that practices, as outlined in "Mississippi's BMPs: Best Management Practices for Forestry in Mississippi" (MFC, 2000), "Planning and Design Manual for the Control of Erosion, Sediment, and Stormwater" (MDEQ, et. al, 1994), and "Field Office Technical Guide" (NRCS, 2000), be followed, respectively.

3.3 Incorporation of a Margin of Safety

The margin of safety is a required component of a TMDL and accounts for the uncertainty about the relationship between pollutant loads and the quality of the receiving water body. The two

types of MOS development are to implicitly incorporate the MOS using conservative model assumptions or to explicitly specify a portion of the total TMDL as the MOS. The MOS selected for this model is implicit.

3.4 Calculation of the TMDL

A predictive model was not used to calculate the TMDL due to the 7Q10 flow being zero. Equation 1 was used to calculate the TMDL for TP and TN. The target concentration was used with the average flow for the watershed to determine the TMDL. The TBODu portion of the TMDL was calculated by setting the background TBODu concentration to 2.0 mg/l and using Equation 1 to find the load. Therefore, the TBODu LA is based on a background concentration of 2 mg/l at the annual average flow. However, the TBODu LA loads will be lower for flows less than the annual average.

Table 10. TMDL

Pollutant	WLA (lbs/day)	LA (lbs/day)	MOS	TMDL (lbs/day)
TBODu	56.24	2228.05	Implicit	2284.29
TN	8.45	1170.58	Implicit	1179.03
TP	3.82	175.84	Implicit	179.66

The nutrient TMDL loads were then compared to the estimated existing loads previously calculated. An 84.56% reduction in TN loading and a 95.33% reduction in TP loading is recommended. Best management practices are encouraged in this watershed to reduce the nonpoint nutrient loads.

3.5 Seasonality and Critical Condition

This TMDL accounts for seasonal variability by requiring allocations that ensure year-round protection of water quality standards, including during critical conditions.

CONCLUSION

Nutrients were addressed through an estimate of a preliminary total phosphorous concentration target and a preliminary total nitrogen concentration target. Based on the estimated existing and target total phosphorous concentrations, this TMDL recommends a 95.33% reduction of the nonpoint phosphorous loads entering these water bodies to meet the preliminary target range of 0.16 mg/l. Based on the estimated existing and target total nitrogen concentrations, this TMDL recommends an 84.56 % reduction of the nonpoint nitrogen loads entering these water bodies to meet the preliminary target range of 1.05 mg/l. Based on the relative size of the load from the one point source in the watershed, no further reduction in required to the WLA. The implementation of BMP activities should reduce the nutrient load entering the creeks. This will provide improved water quality for organic enrichment and the support of aquatic life in the water bodies, and will result in the attainment of the applicable water quality standards.

4.1 Next Steps

MDEQ's Basin Management Approach and Nonpoint Source Program emphasize restoration of impaired waters with developed TMDLs. During the watershed prioritization process to be conducted by the Yazoo River Basin Team, this TMDL will be considered as a basis for implementing possible restoration projects. The basin team is made up of state and federal resource agencies and stakeholder organizations and provides the opportunity for these entities to work with local stakeholders to achieve quantifiable improvements in water quality. Together, basin team members work to understand water quality conditions, determine causes and sources of problems, prioritize watersheds for potential water quality restoration and protection activities, and identify collaboration and leveraging opportunities. The Basin Management Approach and the Nonpoint Source Program work together to facilitate and support these activities.

The Nonpoint Source Program provides financial incentives to eligible parties to implement appropriate restoration and protection projects through the Clean Water Act's Section 319 Nonpoint Source (NPS) Grant Program. This program makes available around $1.6M each grant year for restoration and protections efforts by providing a 60% cost share for eligible projects.

Mississippi Soil and Water Conservation Commission (MSWCC) is the lead agency responsible for abatement of agricultural NPS pollution through training, promotion, and installation of BMPs on agricultural lands. USDA Natural Resource Conservation Service (NRCS) provides technical assistance to MSWCC through its conservation districts located in each county. NRCS assists animal producers in developing nutrient management plans and grazing management plans. MDEQ, MSWCC, NRCS, and other governmental and nongovernmental organizations work closely together to reduce agricultural runoff through the Section 319 NPS Program.

Mississippi Forestry Commission (MFC), in cooperation with the Mississippi Forestry Association (MFA) and Mississippi State University (MSU), have taken a leadership role in the development and promotion of the forestry industry Best Management Practices (BMPs) in Mississippi. MDEQ is designated as the lead agency for implementing an urban polluted runoff control program through its Stormwater Program. Through this program, MDEQ regulates most construction activities. Mississippi Department of Transportation (MDOT) is responsible for implementation of erosion and sediment control practices on highway construction.

Due to this TMDL, projects within this watershed will receive a higher score and ranking for funding through the basin team process and Nonpoint Source Program described above.

4.2 Public Participation

This TMDL will be published for a 30-day public notice. During this time, the public will be notified by publication in the statewide newspaper. The public will be given an opportunity to review the TMDLs and submit comments. MDEQ also distributes all TMDLs at the beginning of the public notice to those members of the public who have requested to be included on a TMDL mailing list. Anyone wishing to become a member of the TMDL mailing list should contact Kay Whittington at Kay_Whittington@deq.state.ms.us.

All comments should be directed to Kay_Whittington@deq.state.ms.us or Kay Whittington, MDEQ, PO Box 10385, Jackson, MS 39289. All comments received during the public notice period and at any public hearings become a part of the record of this TMDL and will be considered in the submission of this TMDL to EPA Region 4 for final approval.

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